Innovative ways to Infuse Mathematical Concepts to Secondary Students through Internet Instructional Resources to design an "Active classroom".

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Abstract: *Mathematics is something that people do. In the ages before the recent rapid developments in technology, this activity called "doing mathematics" has been restricted to those who happened to be able to master a variety of artificial, mechanical, formal processes. Now though, technology allows freedom for many more people to benefit from being able to "do mathematics", and for others to benefit from the results of that. This paper describes one of the initiatives to support teachers in integrating internet resources into the instructional process in Mathematics while shifting their instruction to a more constructivist approach to create an "Active Classroom". To be prepared for the demands of the knowledge economy, students "need to know how to use their knowledge and skills by thinking critically, applying knowledge to new situations, analyzing information, comprehending new ideas communicating, collaborating, solving problems, and making decisions.*

1. Introduction

Before the recent rapid advances in technology, "doing mathematics" was restricted to those who could master a variety of artificial, mechanical, formal processes; what some have called mindless symbolic manipulation of formulae. The mathematician's magic box of symbolic techniques, such as integration, has been an essential tool for a candidate actually to practice mathematics. Technology now allows freedom for many more people to benefit from being able to "do" mathematics. There has always been much more to doing mathematics than just being able to carry out the manipulations, but it can now be viewed more obviously as a broader activity allowing insight into the world, through its structures for communication between reality, words, pictures, and numbers, and a formalised language. Mathematics thus becomes more obviously a "**people**" activity.

Here I present a new way of understanding Mathematical concepts thorough projects, doing things, involved in activities, having conversation with their peers, asking more questions, pupil centered activities, may be tool for assessment *for* learning,. In Singapore we call this "**Teach Less Learn More**". TLLM is about teaching better, to engage our learners and prepare them for life, rather than teaching more, for tests and examinations. It is about shifting the focus from "quantity" to "quality" in education. It is the new way creating more classroom interactions; opportunities for students ask more questions and freedom to express their views and through this building knowledge are very important.

Here I present some examples from my classroom experience this year of incorporating a variety of Internet Instructional Resources and software into our teaching of what we now perceive as doing mathematics, now that rapidly changing technology is here to stay to enhance Mathematics learning in a fun way.

2. Project One

Exploring Planets: Level: Grade 6 to 8.
Topic: Measurement.
Time: 30 min with teacher and 2 hours on their own

OBJECTIVES:

- Students use computers (with internet connection) to gather, organise, manipulate, and express information and ideas.
- Students demonstrate understanding of number concepts.
- Students demonstrate understanding of concepts related to space and dimensionality.
- Students demonstrate understanding of measurement concepts.

OVERVIEW :

Students will use the Internet to find data on two planets. The data retrieved will include each planet's diameter, distances from the sun and earth, length of day and year, range of temperatures, and number of satellites. After retrieving this information they will compare and contrast the data in order to make conclusions about the planets. Student should use their 'My work Space' folder under school LAN to save the retrieved data.

Measurement is something that every body is familiar with because it is used daily. It is important to be able to use measurements accurately in life situations. Often times we can have a general idea with regards to size, length and volume. However, it is important to be able to convert such units of measurement so that we can communicate more efficiently and accurately with each other in the local and global context. Different countries use different units of measurement. Hence, the importance of conversion for common understanding. For example, in Singapore distance is measured in kilometers and in the U.S.A. distance is measured in miles. This lesson integrates real data by using statistical information obtained from a fascinating site in order for students to convert and then compare and contrast the size of the planets.

LEARNING OUTCOMES

After this lesson, students will be able to

- obtain conversion formulae for one unit to another.
- use the diameter to make conclusions.
- calculate the time taken to travel a certain distance when the speed of travel is given.
- differentiate between 2 planets

MATERIALS NEEDED

- computers with access to the Internet
- handout

PROCEDURE

1. Go to the site, http://www.windows.ucar.edu/ "Windows to the Universe"
2. Click on the icon entitled, "Our Solar System"
3. Scroll down to the very bottom of the page. There students will see pictures of each planet.
4. Click on the planet that they would like to obtain statistical information on.
5. Click on the hyperlink "Planetary Facts" to see the information
6. Write down all information needed on handout.
7. Compute all necessary information required on the handout.

EXTENSIONS

Information on 8 planets is available other than ‘Earth’. Divide the class into at least four groups. Let each group take two planets so that all the eight planets are taken by them for exploring. At the end of 2hrs and 30 min session, each group has to submit their report using MS Power point (each group 20 min + 10 min for Q & A). If the group presentations are good (otherwise teacher come to picture to fine tune it), allow the groups to present their finding at school assembly for the whole school.

ASSESSMENT

To assess if students are able to
1) differentiate between 2 planets.
2) check the accuracy of answers to questions 2, 6 and 8 of hand out
3) check the accuracy of conversion of units
4) present their project, noting their presentation and communication skill

3. Project Two

Pick’s Theorem as a System of Equations Level: Grade 7 to 9
Topic: Solving Simultaneous Equations
Time: 2 hours.
OBJECTIVES:

- Students create four figures and measure the number of perimeter pins, number of interior pins, and the resulting area.
- Students use any best two sets of data to construct a system of equations. In two variables **a and b**

OVERVIEW

First, students practice, how to create closed polygons using the digital geoboard and also learn how to find the perimeter and area of the polygons. Using different colours they will create four polygons and calculate the number of perimeter pins(P), number of interior pins(I) and note down these values in a table form and also the area(a) of all the four polygons. Out of the four data, select

any two best data and use the relation
$A = aP + bI - 1$, substitute the values of A,P and I. Solving the two equations algebraically or use matrix algebra to solve system of equations (for additional mathematics students).Find the values of **a and b** the coefficients of Pick's Theorem.

LEARNING OUTCOMES

After this lesson, students will be able to

- relate the number of pins on the perimeter and interior of any polygon.
- see the Pick's constants a and b are unique for any polygon.
- Find out the area of any polygon, given number of perimeter pins and interior pins using the Pick's constants.

Materials: **E-Example Geoboard Applet (need Internet connection)**
http://nlvm.usu.edu/en/nav/frames_asid_279_g_4_t_3.html

Instructional Plan

The main problem in this lesson is to determine the values of the coefficients of the terms in Pick's Theorem. In particular, what are the values of coefficients
a* and *b, in the following equation:
Area = ***a*** (Number of Perimeter Pins) + ***b*** (Number of Interior Pins) - 1

For simpler notation, $A = aP + bI - 1$.

It may be worth a brief discussion to talk about the difference between the coefficients ***a* and *b***, and the variables *P* and *I*. Students need to understand that ***a* and *b*** are merely placeholders that stand for specific, though as yet unknown, values; whereas, *P* and *I* are true variables, in that they change from case to case.

Students create four different figures on their geoboards. The figures should have differed in the number of perimeter pins, the number of interior pins, and the area. As noted in rediscovering the Pattern of Pick's Theorem, the most difficult part is correctly determining the area. Students may check each other's area calculations to ensure that they are correct. With four figures and the corresponding values for *P*, *I*, and *A*, students can select any two sets (P, I and A) of values to create and solve a system of two equations.

For example, consider three figures with the following values:

- $P = 8$, $I = 1$, $A = 4$
- $P = 8$, $I = 4$, $A = 7$

These values yield the following system of equations:

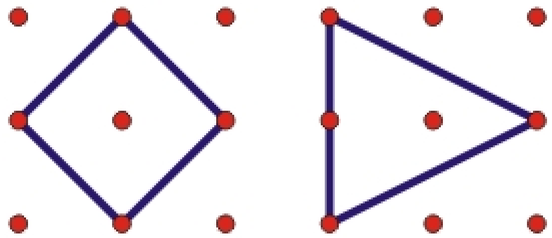
$4 = a(8) + b(1) - 1$
$7 = a(8) + b(4) – 1$
reduces to:
$8a + b = 5$
$8a + 4b = 8$

Solution: $a = ½$, $b = 1$, so Pick's Theorem must be $A = ½P + I - 1$.

Questions for Students

- Why are you asked to find four figures? Can you perform the activity with two figures?
- Explain a situation where a fellow student might think they had two unique figures, but really only has one? That is, why might they think that they had enough examples, but not be able to solve the system of equations?

[The student may have used two figures with the same number of perimeter and interior pins. Although the figures may look different, if the values of *P* and *I* are the same, the system will yield an infinite number of solutions. For instance, consider the two different figures below, both with $P = 4$ and $I = 1$:



Each of these figures give the equation $2 = 4a + b - 1$, so this equation will occur twice in the system. If these equations are subtracted, the result will be the meaningless equation 0 = 0.]

Extensions:

Students choose two random points in the plane and determine the slope and intercept for a line through the two points. The equation is $y = ax + b$, so they will be substituting values for *x* and *y* while trying to solve for ***a* and *b***. This allows for a good discussion why two points are necessary to determine a unique line.

4. Conclusion

The "Active Classroom" concept has taken advantage of the accessibility and availability of Instructional Resources to provide chances for teachers on knowledge development, reflection, peer interaction, observation and demonstration, feedback, self assessment, in personal goal oriented task. As I presented two projects in this paper, these types of professional development activities will gradually induce change to teachers. The learner-centered, learner-oriented model of learning provided by the "Active Classroom" is most suitable for all level of teaching Mathematics and also to apply new concepts into practical classroom practice.

5. References

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